CLAIMS

What is claimed is:

1. A system for increasing Raman emissions from a plurality of Raman active molecules (RAMs) and making an identification therefrom, comprising:

an enhancement mechanism, wherein the enhancement mechanism enhances Raman scattering from the plurality of Raman active molecules (RAMs); and

an interrogator for transmitting a signal toward an object of interest and receiving a return signal therefrom, wherein the return signal includes a Raman signature, and the interrogator classifies an object based on the Raman signature.

2. The system of claim 1, wherein the enhancement mechanism enhances a local electric field about the enhancement mechanism.

3. The system of claim 2, wherein the electric field is enhanced by plasmon resonance.

4. The system of claim 1, wherein the enhancement mechanism is selected from the group consisting of rough metal surfaces, metal nano-spheres, metal shapes of unusual geometry, split ring resonators, deep grooved metal gratings and photonic crystals.

5. The system of claim 1, wherein the enhancement mechanism comprises a plurality of photonic crystals, and the plurality of photonic crystals are selected to have a photonic bandgap such that a Raman signal is outside the photonic bandgap.

6. The system of claim 5, wherein the photonic crystals include at least one defect and at least one Raman active molecule is placed inside the defect.

7. The system of claim 6, wherein the defect is a cavity within at least one photonic crystal.

8. The system of claim 6, further comprising:
a second enhancement mechanism selected from the group consisting of rough metal surfaces, metal nano-spheres, metal shapes of unusual geometry, split ring resonators, and deep grooved metal gratings, wherein the second enhancement mechanism is placed inside the at least one defect.

9. The system of claim 5, wherein the RAMs are placed outside the photonic bandgap.

10. The system of claim 9, wherein the RAMs are placed such that the density of states is increased.

11. The system of claim 1, wherein the interrogator includes a near infra-red excitation source.

12. The system of claim 11, wherein the near infra-red excitation source has a wavelength of about 785 nanometers.

13. The system of claim 1, wherein the interrogator classifies the object as friend or foe.

14. The system of claim 13, further comprising:
at least one marker, wherein the marker includes a plurality of Raman active molecules (RAMs) and the enhancement mechanism.

15. The system of claim 14, wherein the interrogator comprises

an optical generator for generating and transmitting an optical beam;
a computer controller for directing the optical beam toward an object; and
a detector for detecting the return signal.

16. The system of claim 14, wherein the marker comprises a decal, and the enhancement mechanism and the RAMs are embedded on the decal.

17. The system of claim 14, wherein the marker comprises a coating, and the enhancement mechanism and the RAMs are mixed in the coating.

18. The system of claim 17, wherein the coating is applied as a spray.

19. The system of claim 14, wherein the marker is passive.

20. The system of claim 1, wherein the interrogator classifies the object as safe or hazardous.

21. The system of claim 20, wherein the enhancement mechanism is dispersed over a suspect region, and the enhancement mechanism attaches to suspect particles in the suspect region.

22. The system of claim 20, further comprising:
a collector, wherein the collector samples air from a suspect region and combines the air with the enhancement mechanism.

23. The system of claim 22, wherein the collector includes a filter and the filter combines the air with the enhancement mechanism.

24. The system of claim 23, wherein the enhancement mechanism is embedded within the filter.

25. The system of claim 22, wherein the collector is carried into the suspect region by an unmanned device.

26. The system of claim 22, wherein the collector includes an air inlet and an air outlet.

27. The system of claim 26, further comprising:

a reservoir, wherein the reservoir stores the enhancement mechanism and releases a portion of the enhancement mechanism when a new air sample is taken.

28. The system of claim 26, wherein the air inlet and the air outlet include a sealing mechanism which prevents air from entering and exiting the collector.

29. A method for increasing Raman emissions from a plurality of Raman active molecules (RAMs) and making an identification therefrom, comprising the steps of:

providing an enhancement mechanism, wherein the enhancement mechanism enhances Raman scattering from the plurality of Raman active molecules (RAMs);

creating a local electric field about the enhancement mechanism to induce enhanced Raman scattering; and

classifying an object based on a Raman signature produced by the enhanced Raman scattering.

30. The method of claim 29, wherein the step of creating a local electric field about the enhancement mechanism includes inducing plasmon resonance to enhance the local electric field.

31. The method of claim 29, wherein the step of providing an enhancement mechanism includes selecting the enhancement mechanism from the group consisting of rough metal surfaces, metal nano-spheres, metal shapes of unusual geometry, split ring resonators, deep grooved metal gratings and photonic crystals.

32. The method of claim 29, wherein the step of providing an enhancement mechanism includes providing a plurality of photonic crystals, and the plurality of photonic crystals are selected to have a photonic bandgap such that a Raman signal is outside the photonic bandgap.

33. The method of claim 32, wherein the step of providing a plurality of photonic crystals includes using photonic crystals that include at least one defect and placing at least one Raman active molecule inside the defect.

34. The method of claim 33, wherein the step of using photonic crystals that include at least one defect includes forming the defect as a cavity.

35. The method of claim 33, further comprising the steps of:

selecting a second enhancement mechanism from the group consisting of rough metal surfaces, metal nano-spheres, metal shapes of unusual geometry, split ring resonators, and deep grooved metal gratings; and

placing the second enhancement mechanism inside the at least one defect.

36. The method of claim 32, further comprising the step of:

placing a plurality of RAMs outside the photonic bandgap.

37. The method of claim 36, wherein the step of placing the plurality of RAMs outside the photonic bandgap includes placing the RAMs such that the density of states is increased.

38. The method of claim 29, wherein the step of creating a local electric field about the enhancement mechanism includes using a near infra-red excitation source.

39. The method of claim 38, wherein the step of using a near infra-red excitation source includes using an excitation source having a wavelength of about 785 nanometers.

40. The method of claim 29, wherein the step of classifying an object based on a Raman signature includes classifying the object as friend or foe.

41. The method of claim 40, further comprising the step of:

applying at least one marker to an object, wherein the marker includes a plurality of RAMs and the enhancement mechanism.

42. The method of claim 41, wherein the step of applying at least one marker to an object includes using an adhesive to apply the marker.

43. The method of claim 41, wherein the step of applying at least one marker to an object includes spraying the marker on the object.

44. The method of claim 29, wherein the step of classifying an object based on a Raman signature includes classifying the object as safe or hazardous.

45. The method of claim 44, wherein the step of providing an enhancement mechanism includes dispersing the enhancement mechanism over a suspect region.

46. The method of claim 44, further comprising the step of:

collecting air samples from a suspect region; and
combining the air sample with the enhancement mechanism.

47. The method of claim 46, further comprising the step of:
trapping airborne matter in a filter.

48. The method of claim 47, wherein the step of trapping the airborne matter in a filter includes using a filter having the enhancement mechanism embedded in the filter.

49. The method of claim 46, wherein the step of collecting airborne matter includes using an unmanned device to travel into the suspect region.